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ABSTRACT

To examine the validity of short forms of the Wechsler Intelligence Scale for Children-Revised (WISC-R), the WISC-R was first administered to 106 hospitalized psychiatric patients, aged 8-16. No subjects had a primary diagnosis of mental retardation or learning disability, and one-third were receiving psychotropic medication. WISC-R IQ scores ranged from 70 to 133 (mean of 93.76). The WISC-R was administered during the first month of hospitalization. To obtain short form WISC-R scores, Hobby's Split Half Short Form procedure was used. Scoring was modified for all subtests except Digit Span, Coding, and Mazes, usually resulting in a 40-45% shorter test. Both subtest and IQ scores were obtained. Correlations between long form and short form scores on subtests ranged from .76 to .92. Correlations between long and short form results on derived verbal, performance, and full scale IQs were .96 to .98. However, in all instances the mean value yielded by the short form was higher than the corresponding long form result. Differences were statistically significant for four of the nine subtests. Routine use of the short form was not recommended, because of the relatively high rates of classification error, extreme score deviation, and profile dissimilarity. (GDC)

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WISC-R Short Forms: Long On Problems

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WISC-R Short Forms: Long On Problems (2.3/2.2)

Since the development of the Wechsler Intelligence Scales (Wechsler, 1939; 1949; 1963), and their subsequent revisions (Wechsler, 1955; 1974; 1981), numerous published studies have investigated the validity and clinical utility of abbreviated forms of these popular tests. This expression of interest in the development of short forms has been prompted primarily by the need to reduce the length of test administration time in clinical and educational settings having high rates of referrals for intellectual assessment. In addition, the existence of a statistically and clinically valid abbreviation of the Wechsler tests would be a welcomed tool in many clinical settings as a means of circumventing problems related to fatigue, attention and motivation which might invalidate the results of a standard administration of the complete test (Burns, Elias, Hitchcock, & St. Germain, 1978). The combination of these pragmatic and clinical concerns is especially apparent in the evaluation of children or when the Wechsler scales are included as part of a lengthy neuropsychological battery requiring many hours for administration.

Although a variety of procedures have been proposed for shortening the Wechsler Scales, these can be essentially

divided into two basic types: selected-subtest and selected-item formats. As the name implies, selected-subtest methods involve a reduction in the number of subtests administered. Various subtest combinations containing from two to six subtests have been suggested on the basis of either theoretical (e.g., Ryan, 1981) or empirical (e.g., Beck, Ray, Seidenberg, Young, & Gamache, 1983) considerations. IQ values are estimated either by prorating the scores of the retained subtests and then utilizing the usual tables for obtaining the IQ, or by the use of multiple regression equations. Whereas this procedure effectively shortens test administration time, it precludes the diagnostically relevant analysis of inter-subtest variability. In contrast, selected-item or split-half procedures retain the battery's multiple subtest composition by reducing the number of items administered from each subtest (e.g., Satz & Mogel, 1962; Yudin, 1966). Both random and empirical methods have been employed in the selection of items (Goh, 1979). Thus, the design of selected-item formats allows for the examination of performance variability while still providing a substantial reduction in administration time.

Among the selected-item formats applied to the Wechsler Intelligence Scale for Children - Revised (WISC-R), the Split-Half Short Form developed by Hobby (1982) represents the most thoroughly validated set of procedures. He chose to preserve the multiple subtest format of the battery, in part, so that ". . . the examiner can still use research information that identifies relevant subtest scaled score patterns" (p. 20). The Split-Half procedures modify the administration and scoring of all subtests except Digit Span, Coding, and Mazes, and are purported to effect a 40-45% savings in administration time. The starting point for all subtests is the same as for the standard WISC-R, except for Arithmetic and Vocabulary where starting points vary with the child's age. Odd-numbered items are administered on all of the altered subtests except Block Design which retains items numbered 1, 3, 4, 6, 8, and 10. Raw scores are essentially obtained by summing the child's score on administered items and multiplying by two. Scaled scores are then determined in the usual manner by reference to the tabled values in the WISC-R manual, although various correction factors may be applied depending on the child's age and level of performance. Summation of the obtained subtest

scaled scores is used for determining the Verbal, Performance, and Full-Scale IQs from the WISC-R manual and, again depending on age and performance level, these also may be subject to various correction factors.

The use of abbreviated Wechsler scales has been investigated in a variety of child populations, including: normal (Dean, 1977); gifted (Karnes & Brown, 1981); mentally retarded (Finch, Ollendick, & Ginn, 1973); brain damaged (Reid, Moore, & Alexander, 1966); delinquent (Haynes, 1982); disadvantaged (Piersel, Brady, & Kratochwill, 1977); school referred with learning and/or behavioral problems (Ryan, 1981); and out-patient psychiatric (Beck et al., 1983). The present investigation sought to extend this research by determining the validity and clinical utility of an abbreviated WISC-R in an inpatient psychiatric population. The diagnostically relevant analysis of subtest scatter was felt to be a desirable attribute for a short form test in this setting and, therefore, the selected-item procedures proposed by Hobby (1982) were chosen for study.

Method

Subjects

Subjects in this study were 73 male and 33 female child and adolescent psychiatric patients ranging from

8 to 16 years of age ($M = 12.87$, $SD = 2.61$). IQ, as determined by the complete administration of the WISC-R, ranged from 70 to 133 ($M = 93.76$, $SD = 14.73$), with no subject carrying a primary diagnosis of mental retardation or learning disability. All subjects were hospitalized at the time of testing, and the sample was heterogeneous with respect to severity and chronicity of psychiatric disturbance. Finally, this was a sample receiving a variety of treatments, with approximately one-third receiving some type of psychotropic medication at the time of evaluation.

Testing Procedures

All subjects were tested individually, usually within the first month of hospitalization, by a thoroughly trained examiner, and received a standard administration of the WISC-R as part of a complete psychological evaluation. However, the Mazes subtest was not administered to any subject, and thirteen subjects did not receive the Digit Span subtest. Scoring accuracy on all protocols was checked by a second examiner. Each protocol was then rescored according to the procedures presented by Hobby (1982) to obtain the short form estimates of subtest and IQ values.

Results

Table 1 presents the means and standard deviations of all subtest scaled scores and IQ values derived from the Long Form (LF) and Split-Half (SH) WISC-R. Pearson product-moment correlations between corresponding scores of the two forms were all significant beyond the .001 level. Since we were not examining part-whole comparisons between the two test forms but, rather, the degree of correspondence between two different methods at deriving scaled scores and IQ values, correlations between measures were not corrected for item overlap. For the subtests, correlations ranged from .76 for Object Assembly to .92 for Block Design (M = .87). Correlations between the LF and SH derived Verbal, Performance, and Full Scale IQ's were .96, .96, and .98, respectively. Nevertheless, despite the very high degree of correspondence between these two sets of scores, in all instances the mean value yielded by the SH procedures was higher than their LF counterparts. In examining these differences we wanted to be careful not to miss any statistically significant differences that would result between the two batteries, and t-tests were therefore corrected for correlated samples. Differences between the LF and SH were found to be significant

for four (4) of the nine (9) subtests modified by the SH procedures (i.e., Information, Comprehension, Picture Arrangement, and Block Design), and for all three summary IQ values.

Insert Table 1 about here

Table 2 presents the mean factor scores derived from the LF and SH batteries when the subtests were grouped according to Kaufman's (1979) three factors. As was observed with the individual subtests, the SH yielded consistently higher factor scores than the LF. These differences were significant ($p < .01$) for the Verbal Comprehension and Perceptual Organization factors, each of which contains loadings from 2 of the 4 individual subtests which differed significantly between the two test forms. The difference between batteries for the third factor, Freedom from Distractibility, was not significant since it is composed of Digit Span and Coding, which are unaltered by the Split-Half procedures, and Arithmetic, which did not produce appreciably different scores in the two tests.

Insert Table 2 about here

Rates of agreement between the LF and SH batteries in assigning a child to one of Wechsler's seven categories of IQ classification are presented in Table 3. As shown, for the total sample there was an 81.1% rate of agreement between test forms. Instances of misclassification never exceeded one category level in either direction. Also, misclassifications were about twice as likely to reflect an overestimation of the LF rather than an underestimation. These results were further analyzed by subdividing the sample into Above Average (110+), Average (90-109), and Below Average ($\leq$ 89) level subjects on the basis of the LF Full Scale IQ. Although Chi Square analysis of these data did not reach significance ($X^2 = 9.45$, $df = 4$, $p > .05$), the direction of misclassification by the SH tended to differ between the three groups, with a greater incidence of underestimation of Above Average children and overestimation of Average and Below Average children.

Insert Table 3 about here

Table 4 lists the percentage of subjects obtaining SH subtest and IQ scores which differed from their LF results by an amount equal to or greater than one and two

standard errors of measurement. Whereas the t-test comparisons presented in Table 1 will tend to average out LF-SH discrepancies across subjects, these comparisons specifically highlight intra-subject differences between the two test forms. Using normal curve probabilities, 31.74% and 4.56% of subjects would be expected to meet the 1 SEM and 2 SEM criteria, respectively. As shown in Table 4, the observed incidence of LF-SH discrepancy exceeded these expected frequencies for 6 subtests at the 1 SEM level, 8 subtests at the 2 SEM level, and all three IQ values at both levels. It is particularly striking that at the 2 SEM level, four subtests (i.e., Information, Similarities, Picture Completion, and Object Assembly) showed a greater than 10% incidence of LF-SH disparity. It should be noted that, except for Information, these were not the same subtests identified by the t-test comparisons.

Insert Table 4 about here

Table 5 presents the rates of agreement between the two batteries in detecting significant/nonsignificant Verbal-Performance IQ differences, regardless of direction.

Overall, there was an 81.1% rate of agreement between test forms. The percentage of misclassification was relatively evenly divided with respect to the type of error, with the SH form being equally likely to overestimate or underestimate the significance of the LF Verbal-Performance difference. The rate of agreement between batteries in classifying the Verbal-Performance discrepancies was not found to be significantly different among Above Average, Average, and Below Average ability children ($X^2 = 3.49$, $df = 4$, $p > .30$).

Insert Table 5 about here

Using subtest scaled scores, the LF and SH data were subjected to separate principal-components factor analyses followed by varimax (orthagonal) rotation of factors with eigenvalues greater than one. The two batteries revealed highly similar factor structures, with the LF and SH each yielding two factors (accounting for 61% and 55% of the total variance, respectively) corresponding to the Verbal and Performance scale dichotomy. In each instance, the Arithmetic and Picture Arrangement subtests showed moderately high loadings on both factors. The factor structure of both batteries is depicted in Figure 1.

Insert Figure 1 about here

The similarity in patterns of the subtest profiles generated by the Long and Split-Half Forms was assessed using Cattell's pattern similarity coefficient, r_p (Cattell, Coulter, & Tsujioka, 1966). The r_p coefficient is analagous to the correlation coefficient in that it can assume values ranging from -1.0 to +1.0 with the same interpretational meaning attached to its directional sign. In addition, r_p is sensitive to differences in profile level, shape, and variability. A value for r_p was computed for each subject. Figure 2 illustrates profile comparisons at four different levels of r_p. In comparing 9 profile elements a minimum value for r_p of .43 is required for significance at the .05 level, and of .60 at the .01 level (Horn, 1961). Values of r_p in the sample ranged from .28 to .95 and, using Fisher's Z transformation, a mean value of .75 was found. The formula used in this analysis to compute r_p was not corrected for the inflation that occurs with correlated profiles (Cattell et al., 1966). Therefore, alpha was conservatively set at .01 ($r_p \geq .60$) to determine the significance of each child's

profile similarity, with 80.2% of the sample meeting this criterion of profile validity.

Insert Figure 2 about here

Discussion

Examination of the data presented in this study raises several questions concerning the validity and clinical utility of the SH WISC-R. Resnick (Resnick & Entin, 1971; Resnick, 1977) has proposed three criteria to be used in evaluating the validity of short forms: (1) highly significant correlations; (2) non-significant t-tests; and (3) minimal changes in IQ classification. The present results readily meet the criterion of highly significant correlations and, in fact, the magnitude and pattern of our results are remarkably similar to those obtained in Hobby's (1982) original validation sample.

As regards the second criterion of non-significant t-tests, differences between means in the present study were significant for four of nine subtests and all three IQ values. These results were not unexpected, however, since Hobby's (1982) comparisons between means at ten age levels (for a total of 90 subtest and 30 IQ comparisons)

revealed 49 subtest and 21 IQ differences which reached significance, with a tendency toward overestimation by the SH procedures as was observed with our data. Hobby cogently argues, though, that the use of t-tests for differences between correlated means may define statistical significance too narrowly to equate the results with practical significance (p. 26). A similar argument may apply for the present results where differences between means ranged from .05 to .75 for subtest scaled scores, and from 1.12 to 1.40 for IQ values.

Defining an acceptable ratio of IQ misclassification by short form tests is, perhaps, a matter open to individual interpretation. In Hobby's original sample, 7.8% of subjects were misclassified (92.2% agreement), by the SH procedures, or approximately one child in every thirteen. This rate of misclassification was more than doubled in the present sample, with 18.9% of subjects, or about one in every five, being assigned to an incorrect IQ category. In a clinical setting engaging in routine diagnostic assessment this would seem to be an unacceptably high rate of classification error. A concern in this regard appears particularly warranted when one considers the unexpectedly high frequency of subjects found in this

study who obtained SH subtest and IQ scores differing from their LF results by two or more SEM.

In addition to the criteria outlined above, SH validity was also assessed in the present study through an examination of profile similarity between the two test batteries. Grouping subtests according to Kaufman's (1979) three factors revealed significant differences between LF and SH tests for the Verbal Comprehension and Perceptual Organization factors. As noted above, though, the use of t-tests corrected for correlation may have uncovered significant differences having little practical meaning. The highly similar factor structure between the two test forms demonstrated in this study would suggest that, at least for intra-subject comparisons, the use of factor scores may be an appropriate method for examining SH profile variability. However, further analysis of subtest pattern similarities between LF and SH batteries disclosed that nearly 20% of our sample failed to meet the criterion established for profile validity. This result would fail to support the contention that SH procedures permit a valid interpretation of diagnostically relevant subtest patterns.

In summary, the results of the present study indicate a number of potential problems associated with the application of WISC-R short forms in clinical practice. Although there are some impressive correspondencies between the SH and LF procedures, the relatively high rates of classification error, extreme score deviation, and profile disimilarity observed in our sample would argue against the routine use of SH procedures. This conclusion may apply particularly to psychiatric populations where the presence of emotional and behavioral disturbance already contributes potential error variance to formal assessment procedures. Additionally, in the absence of support for profile validity, the continued use of SH procedures for abbreviating the WISC-R appears unwarranted. In instances where a rapid estimate of a child's IQ is desirable, the use of a brief selected subtest method, such as the Vocabulary-Block Design dyad (Ryan, 1981), may prove more pragmatic.

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Table 1

Comparison Between Long Form and Split-Half WISC-R[a] Subtests and Composite Scores (N=106)

WISC-R Variable	Long Form[b] M	SD	Split-Half[c] M	SD	t[d]
Information	8.68	2.81	9.20	2.77	3.69**
Similarities	9.35	3.07	9.71	3.63	ns
Arithmetic	8.52	2.79	8.69	2.53	ns
Vocabulary	8.45	2.94	8.50	2.94	ns
Comprehension	8.57	3.09	8.97	3.34	2.52*
Digit Span[e]	7.92	2.74	f		
Picture Completion	10.05	2.87	10.34	3.44	ns
Picture Arrangement	10.20	2.97	10.95	3.42	4.47**
Block Design	9.70	3.41	10.03	3.47	2.47*
Object Assembly	10.43	2.95	10.83	3.13	ns
Coding	7.68	3.34	f		
Verbal IQ	91.82	14.91	93.08	14.95	3.13*
Performance IQ	97.15	15.30	98.55	15.39	3.21**
Full Scale IQ	93.76	14.73	94.88	14.50	3.79**

[a]Wechsler Intelligence Scale for Children - Revised
[b]Based on the procedures presented by Wechsler (1974)
[c]Based on the procedures presented by Hobby (1982)
[d]t-tests corrected for correlated samples
[e]n=93
[f]Administration and scoring of Digit Span and Coding is unaltered by the Split-Half procedures
*$p \leq .05$
**$p \leq .01$

Table 2

Comparison Between Split-Half and Long-Form WISC-R[a] Scores for Verbal Comprehension, Perceptual Organization and Freedom from Distractibility Factors[b] (N=106)

Factor	Long Form[c] M	Long Form[c] SD	Split-Half[d] M	Split-Half[d] SD	t[e]
Verbal Comprehension[f]	8.76	2.52	9.09	2.56	4.24**
Perceptual Organization[g]	10.09	2.38	10.54	2.41	5.42**
Freedom from Distractibility[h]	7.97	2.33	8.04	2.21	ns

[a]Wechsler Intelligence Scale for Children - Revised

[b]Based on Kaufman (1979)

[c]Based on Wechsler (1974)

[d]Based on Hobby (1982)

[e]t-tests corrected for correlated samples

[f]Based on the mean for the following subtests: Information, Similarities, Vocabulary, and Comprehension

[g]Based on the mean for the following subtests: Picture Completion, Picture Arrangement, Block Design, and Object Assembly

[h]Based on the mean for the following subtests: Arithmetic, Digit Span, and Coding (n=93)

**$p \leq .01$

Table 3

IQ Classification Agreement Between Long Form[a] and Split-Half[b] WISC-R[c] for Above Average, Average, and Below Average Ability Subjects

IQ Level	n	Percentage of Subjects[d] LF>SH	LF=SH	LF<SH
Total Sample	106	5.7	81.1	13.2
Above Average 110+	14	21.4	71.4	7.1
Average 90-109	49	6.1	81.6	12.2
Below Average 89 and Below	43	0	83.7	16.3

[a]Based on the procedures presented by Wechsler (1974)

[b]Based on the procedures presented by Hobby (1982)

[c]Wechsler Intelligence Scale for Children - Revised

[d]Based on the following IQ classifications: Very Superior = 130+; Superior = 120-129; High Average = 110-119; Average = 90-109; Low Average = 80-89; Borderline = 70-79; Mentally Defective = 69 and below. LF>SH signifies an underestimation of the subject's IQ by the Split-Half form. LF=SH signifies accurate classification of the subject's IQ by the Split-Half form. LF<SH signifies overestimation of the subject's IQ by the Split-Half form.

Table 4

Percentage of Subjects with Subtest and IQ Differences Equal to or Greater than One and Two Standard Errors of Measurement[a]

WISC-R[b] Variable	Percentage ≥ 1 SEM	Percentage ≥ 2 SEM
Information	34	13.2
Similarities	31	10.4
Arithmetic	18.9	1.9
Vocabulary	41.5	7.5
Comprehension	37.7	7.5
Picture Completion	44.3	12.3
Picture Arrangement	46.2	5.7
Block Design	22.6	9.4
Object Assembly	44.3	10.4
Verbal IQ	36.8	5.7
Performance IQ	33	6.6
Full Scale IQ	33	8.5

[a]Based on Wechsler (1974)

[b]Wechsler Intelligence Scale for Children - Revised

Table 5

Rates of Agreement Between Long Form[a] and Split-Half[b] WISC-R[c] in Detecting Significant Verbal-Performance Differences[d] for Above Average, Average, and Below Average Ability Subjects

IQ Level	n	Percentage of Subjects[d] LF>SH[e]	LF=SH[f]	LF<SH[g]
Total Sample	106	8.5	81.1	10.4
Above Average 110+	14	7.1	85.7	7.1
Average 90-119	49	4.1	83.7	12.2
Below Average 89 and Below	43	14	79	7

[a]Based on the procedures presented by Wechsler (1974)

[b]Based on the procedures presented by Hobby (1982)

[c]Wechsler Intelligence Scale for Children - Revised

[d]A difference of 12 or more points between the Verbal and Performance IQ's was considered significant

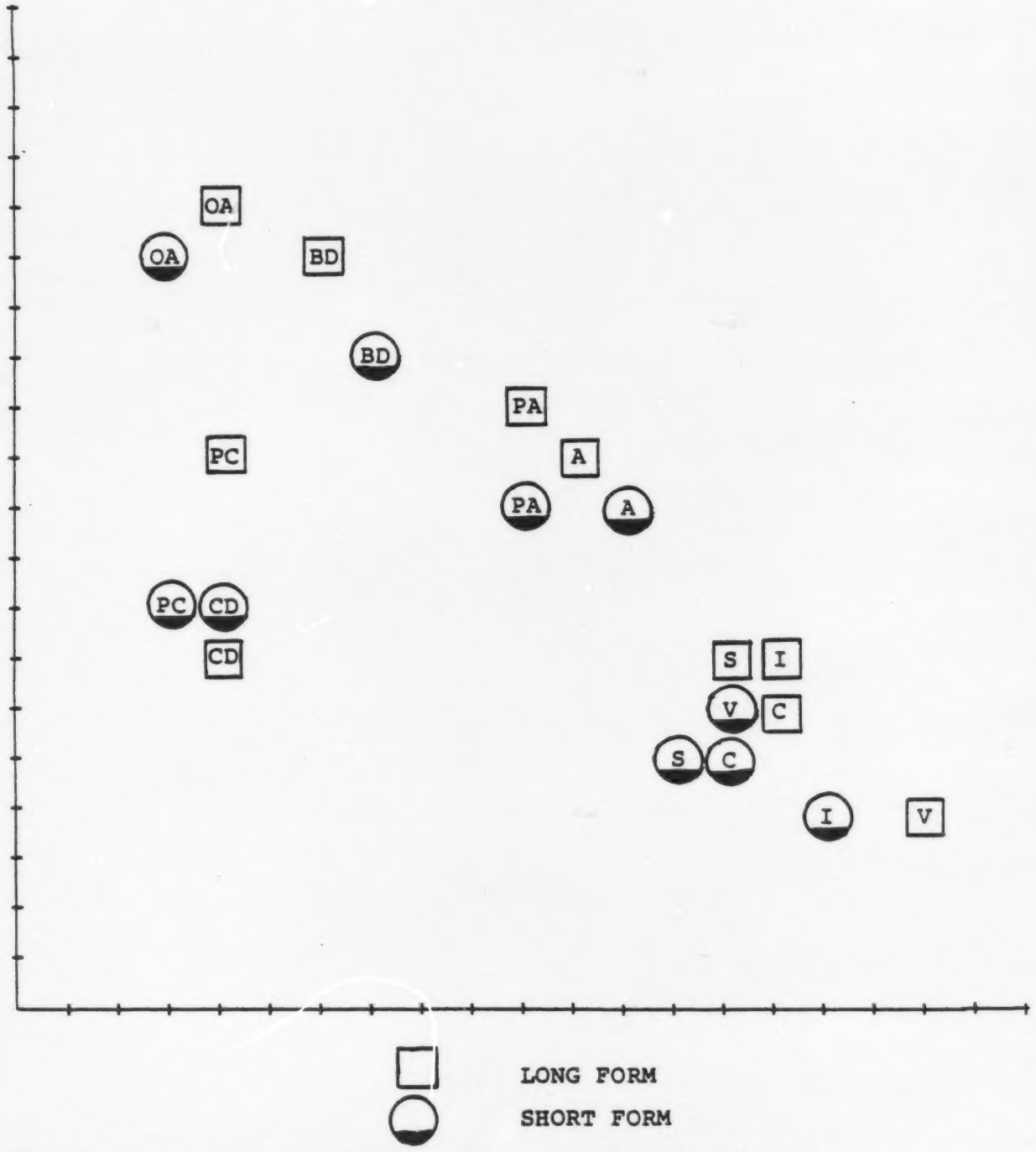
[e]LF>SH indicates a significant V-P difference on the Long Form which was not detected by the Split-Half WISC-R

[f]LF=SH indicates accurate classification of a subject's V-P difference by the Split-Half WISC-R

[g]LF<SH inidcates a non-significant V-P difference on the Long Form which was estimated to be significant by the Split-Half WISC-R

Figure 1

Rotated Orthagonal Factors for Long[a] and Split-Half[b] WISC-R[c] Forms



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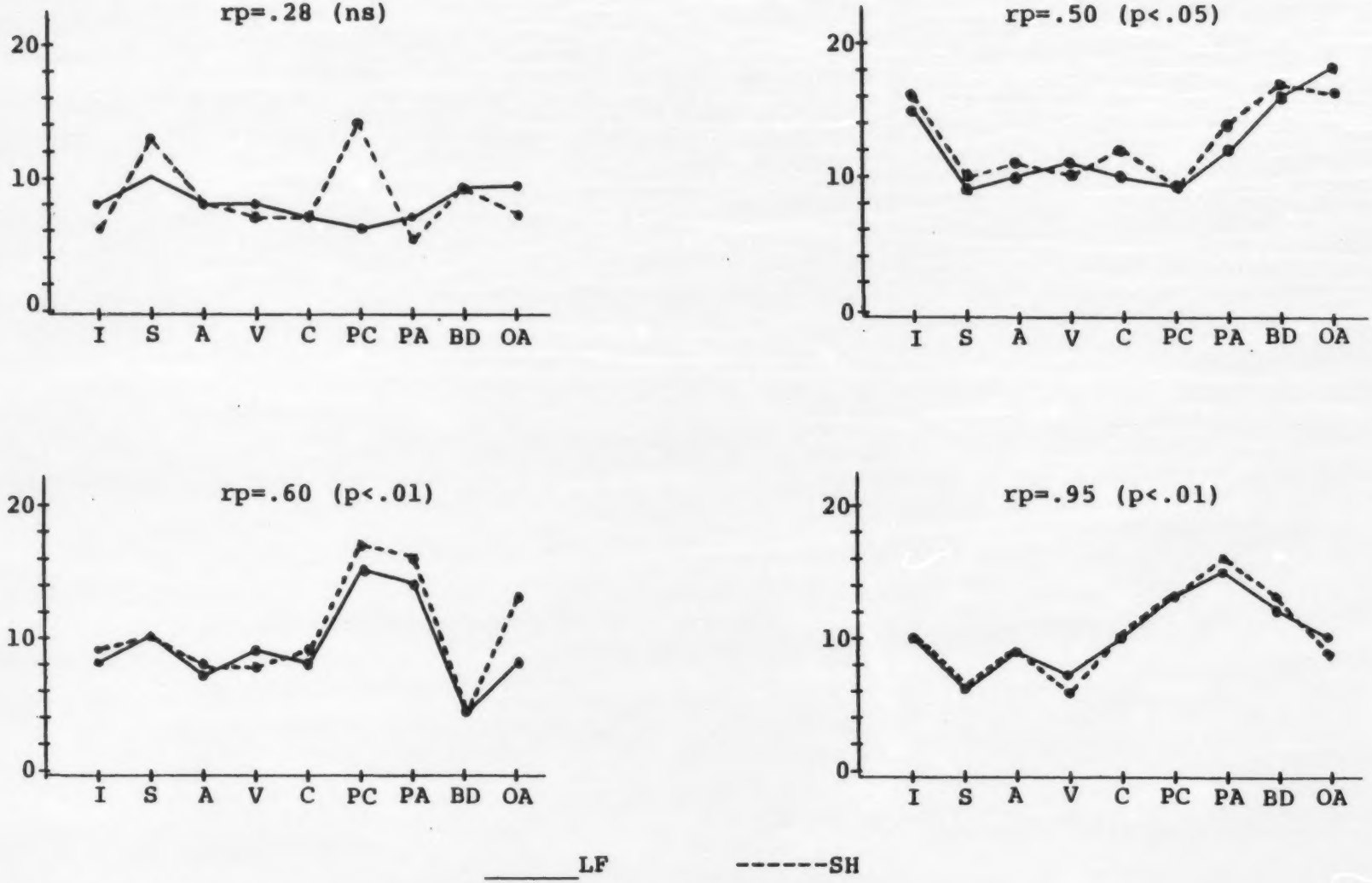
[a]Based on the procedures presented by Wechsler (1974)
[b]Based on the procedures presented by Hobby (1982)
[c]Wechsler Intelligence Scale for Children - Revised
[d]I=Information; S=Similarities; A=Arithmetic; V=Vocabulary; C=Comprehension; PC=Picture Completion; PA=Picture Arrangement; BD=Block Design; OA=Object Assembly; CD=Coding

Figure 2

Profile Comparisons Between Long[a] and Split-Half[b] WISC-R[c] Representing Four Different Levels of rp[d]



[a]Based on the procedures presented in Wechsler (1974)
[b]Based on the procedures presented in Hobby (1982)
[c]Wechsler Intelligence Scale for Children - Revised